



California Regional Water Quality Control Board Central Valley Region



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TO: Technical Staff
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DATE: 1 April 2004

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SUBJECT: BENEFICIAL USE-PROTECTIVE WATER QUALITY LIMITS
FOR COMPONENTS OF PETROLEUM-BASED FUELS

This memorandum summarizes available water quality limits for petroleum fuel mixtures, constituents and additives. Some of the relevant limits have recently changed. The discussion below explains how numerical water quality limits may be used to translate applicable water quality objectives for groundwater. The attached table contains available limits recommended for each applicable objective.

Discussion:

A significant amount of our work involves the assessment and mitigation of petroleum-based fuel spills into soil and water. Various water quality limits have been cited by staff in determining whether beneficial uses have been impaired or threatened by such spills. In an effort to achieve uniformity in the use of numerical water quality limits for this purpose and to bring to your attention the wide range of available and relevant limits, I offer the list on the following pages. These limits are intended to be used to interpret applicable Basin Plan water quality objectives for the protection of existing or potential sources of drinking water. Sources of drinking water are surface and ground waters which have the beneficial use of municipal and domestic supply (MUN), as designated in the applicable *Water Quality Control Plan* (Basin Plan) or the State Water Board "Sources of Drinking Water" Policy, Resolution No. 88-63. Water quality objectives applicable to MUN waters include *Chemical Constituents* (which requires compliance with California drinking water MCLs and generally prohibits adverse effects on beneficial uses), *Toxicity* (which prohibits toxic chemicals in toxic amounts) and *Tastes and Odors* (which prohibits adverse tastes and odors or nuisance conditions). Additional objectives and numerical limits may apply to petroleum fuels in surface waters in addition to those contained in this memorandum.

The *Policy for Application of Water Quality Objectives*, in Chapter IV of the Basin Plans, requires consideration of numerical water quality limits to implement each of these objectives. In most cases, the most stringent of the listed limits for each chemical would implement all objectives applicable to groundwater. A discussion of the use of numerical limits to implement narrative water quality objectives is contained in the staff report *A Compilation of Water Quality Goals*.

Certain of the recommended limits are lower than applicable analytical detection limits in water. In these cases, the confirmed detection of any amount of these constituents in water indicates that beneficial uses have been impaired.

In addition, an assessment of existing and potential water quality impacts must take into account State Water Board Resolution Nos. 68-16, *Statement of Policy With Respect to Maintaining High Quality of Waters in California*, and 92-49, *Policies and Procedures for Investigation and Cleanup and Abatement of Discharges Under Water Code Section 13304*. Conformance with these policies in the Central Valley Region is described in the Chapter IV of the Basin Plans under the headings, *Antidegradation Implementation Policy* and *Policy for Investigation and Cleanup of Contaminated Sites*. Requiring cleanup to technologically and economically achievable levels which are lower than beneficial use-protective limits, would be consistent with these policies for water quality control.

Attachment

JBM\H:\Documents\W. Q. Goals\Memos\Limits_For_Fuels_April_2004.doc

Water Quality Numerical Limits for Petroleum Fuel Mixtures, Constituents and Additives

| Constituent | Water Quality Objective (a) | Numerical Limit Interpreting Water Quality Objective | | |
|---|-----------------------------|--|---------|-------|
| | | Source | Limit | Units |
| Aromatic Hydrocarbons: | | | | |
| Benzene | Chemical Constituents | California Primary MCL (b) | 1.0 | ug/L |
| | Toxicity | California Public Health Goal (OEHHA) | 0.15 | ug/L |
| | Tastes and Odors | Amoore and Hautala, <i>J. Applied Tox.</i> , Vol.3, No.6, 1983 | 170 | ug/L |
| n-Butylbenzene | Toxicity | California Drinking Water Action Level (DHS) | 260 | ug/L |
| sec-Butylbenzene | Toxicity | California Drinking Water Action Level (DHS) | 260 | ug/L |
| tert-Butylbenzene | Toxicity | California Drinking Water Action Level (DHS) | 260 | ug/L |
| Ethylbenzene | Chemical Constituents | California Primary MCL (b) | 300 | ug/L |
| | Toxicity | California Public Health Goal (OEHHA) | 300 | ug/L |
| | Tastes and Odors | Federal Register, Vol. 54, No. 97, pp. 22138,22139 | 29 | ug/L |
| Isopropyl benzene | Toxicity | USEPA IRIS Reference Dose (i) | 700 | ug/L |
| | Tastes and Odors | Amoore and Hautala, <i>J. Applied Tox.</i> , Vol.3, No.6, 1983 | 0.8 | ug/L |
| Toluene | Chemical Constituents | California Primary MCL (b) | 150 | ug/L |
| | Toxicity | California Public Health Goal (OEHHA) | 150 | ug/L |
| | Tastes and Odors | Federal Register, Vol. 54, No. 97, pp. 22138,22139 | 42 | ug/L |
| 1,2,4-Trimethylbenzene | Toxicity | California Public Health Goal (OEHHA) | 330 | ug/L |
| | Tastes and Odors | Amoore and Hautala, <i>J. Applied Tox.</i> , Vol.3, No.6, 1983 | 15 | ug/L |
| 1,3,5-Trimethylbenzene | Toxicity | California Public Health Goal (OEHHA) | 330 | ug/L |
| | Tastes and Odors | Amoore and Hautala, <i>J. Applied Tox.</i> , Vol.3, No.6, 1983 | 15 | ug/L |
| Xylenes (sum of isomers) | Chemical Constituents | California Primary MCL (b) | 1750 | ug/L |
| | Toxicity | California Public Health Goal (OEHHA) | 1800 | ug/L |
| | Tastes and Odors | Federal Register, Vol. 54, No. 97, pp. 22138,22139 | 17 | ug/L |
| Aliphatic Hydrocarbons: | | | | |
| n-Hexane | Toxicity | USEPA Health Advisory (e) | 400 | ug/L |
| | Tastes and Odors | Amoore and Hautala, <i>J. Applied Tox.</i> , Vol.3, No.6, 1983 | 6.4 | ug/L |
| Hydrocarbon Mixtures: | | | | |
| Diesel or Kerosene | Toxicity | USEPA Superfund Provisional Reference Dose (i) | 56-140 | ug/L |
| | Tastes and Odors | Taste & odor threshold from USEPA Health Advisory | 100 | ug/L |
| Gasoline | Toxicity | USEPA Superfund Provisional Cancer Slope Factor (c) | 21 | ug/L |
| | Tastes and Odors | McKee & Wolf, <i>Water Quality Criteria</i> , SWRCB, p. 230 | 5 | ug/L |
| Additives: | | | | |
| Lead | Chemical Constituents | California Primary MCL (b) | 15 | ug/L |
| | Toxicity (h) | California Public Health Goal (OEHHA) | 2 | ug/L |
| Ethylene dibromide (EDB) | Chemical Constituents | California Primary MCL (b) | 0.05 | ug/L |
| | Toxicity | California Public Health Goal (OEHHA) | 0.01 | ug/L |
| Ethylene dichloride (1,2-Dichloroethane) | Chemical Constituents | California Primary MCL (b) | 0.5 | ug/L |
| | Toxicity | California Public Health Goal (OEHHA) | 0.4 | ug/L |
| | Tastes and Odors | Amoore and Hautala, <i>J. Applied Tox.</i> , Vol.3, No.6, 1983 | 7000 | ug/L |
| Methyl t-butyl ether (MtBE) | Chemical Constituents | California Primary MCL (b) | 13 | ug/L |
| | Chemical Constituents | California Secondary MCL (f) | 5 | ug/L |
| | Toxicity | California Public Health Goal (OEHHA) | 13 | ug/L |
| | Tastes and Odors | California Secondary MCL | 5 | ug/L |
| Di-isopropyl ether (DIPE) | Tastes and Odors | Amoore and Hautala, <i>J. Applied Tox.</i> , Vol.3, No.6, 1983 | 0.8 | ug/L |
| t-Butyl alcohol (TBA) | Toxicity | California Drinking Water Action Level (DHS) | 12 | ug/L |
| | Tastes and Odors | Amoore and Hautala, <i>J. Applied Tox.</i> , Vol.3, No.6, 1983 | 290,000 | ug/L |
| Ethanol | Tastes and Odors | Amoore and Hautala, <i>J. Applied Tox.</i> , Vol.3, No.6, 1983 | 760,000 | ug/L |
| Methanol | Toxicity | USEPA IRIS Reference Dose (i) | 3500 | ug/L |
| | Tastes and Odors | Amoore and Hautala, <i>J. Applied Tox.</i> , Vol.3, No.6, 1983 | 740,000 | ug/L |

Water Quality Numerical Limits for Petroleum Fuel Mixtures, Constituents and Additives

| Constituent | Water Quality Objective (a) | Numerical Limit Interpreting Water Quality Objective | | | OEHHA PEF |
|--|-----------------------------|--|---------|-------|-----------|
| | | Source | Limit | Units | |
| Polynuclear Aromatic Hydrocarbons (PAHs or PNAs) and derivatives: | | | | | |
| Acenaphthene | Toxicity | USEPA IRIS Reference Dose (i) | 420 | ug/L | |
| | Tastes and Odors | USEPA National Ambient Water Quality Criteria | 20 | ug/L | |
| Anthracene | Toxicity | USEPA IRIS Reference Dose (i) | 2100 | ug/L | |
| Benz(a)anthracene | Toxicity | Public Health Goal for benzo(a)pyrene & OEHHA PEFs | 0.04 | ug/L | 0.1 |
| Benzo(a)pyrene | Chemical Constituents | California Primary MCL | 0.2 | ug/L | |
| | Toxicity | Public Health Goal | 0.004 | ug/L | 1 (index) |
| Benzo(b)fluoranthene | Toxicity | Public Health Goal for benzo(a)pyrene & OEHHA PEFs | 0.04 | ug/L | 0.1 |
| Benzo(j)fluoranthene | Toxicity | Public Health Goal for benzo(a)pyrene & OEHHA PEFs | 0.04 | ug/L | 0.1 |
| Benzo(k)fluoranthene | Toxicity | Public Health Goal for benzo(a)pyrene & OEHHA PEFs | 0.04 | ug/L | 0.1 |
| Chrysene | Toxicity | Public Health Goal for benzo(a)pyrene & OEHHA PEFs | 0.4 | ug/L | 0.01 |
| Dibenz(a,j)acridine | Toxicity | Public Health Goal for benzo(a)pyrene & OEHHA PEFs | 0.04 | ug/L | 0.1 |
| Dibenz(a,h)acridine | Toxicity | Public Health Goal for benzo(a)pyrene & OEHHA PEFs | 0.04 | ug/L | 0.1 |
| Dibenz(a,h)anthracene | Toxicity | Cal/EPA Cancer Potency Factor (c) | 0.0085 | ug/L | |
| 7H-Dibenzo(c,g)carbazole | Toxicity | Public Health Goal for benzo(a)pyrene & OEHHA PEFs | 0.004 | ug/L | 1 |
| Dibenzo(a,e)pyrene | Toxicity | Public Health Goal for benzo(a)pyrene & OEHHA PEFs | 0.004 | ug/L | 1 |
| Dibenzo(a,h)pyrene | Toxicity | Public Health Goal for benzo(a)pyrene & OEHHA PEFs | 0.0004 | ug/L | 10 |
| Dibenzo(a,l)pyrene | Toxicity | Public Health Goal for benzo(a)pyrene & OEHHA PEFs | 0.0004 | ug/L | 10 |
| Dibenzo(a,l)pyrene | Toxicity | Public Health Goal for benzo(a)pyrene & OEHHA PEFs | 0.0004 | ug/L | 10 |
| 7,12-Dimethylbenz(a)anthracene | Toxicity | Cal/EPA Cancer Potency Factor (c) | 0.00014 | ug/L | |
| 1,6-Dinitropyrene | Toxicity | Public Health Goal for benzo(a)pyrene & OEHHA PEFs | 0.0004 | ug/L | 10 |
| 1,8-Dinitropyrene | Toxicity | Public Health Goal for benzo(a)pyrene & OEHHA PEFs | 0.004 | ug/L | 1 |
| Fluoranthene | Toxicity | USEPA IRIS Reference Dose (i) | 280 | ug/L | |
| Fluorene | Toxicity | USEPA IRIS Reference Dose (i) | 280 | ug/L | |
| Indeno(1,2,3-c,d)pyrene | Toxicity | Public Health Goal for benzo(a)pyrene & OEHHA PEFs | 0.04 | ug/L | 0.1 |
| 3-Methylcholanthrene | Toxicity | Cal/EPA Cancer Potency Factor (c) | 0.0016 | ug/L | |
| 5-Methylchrysene | Toxicity | Public Health Goal for benzo(a)pyrene & OEHHA PEFs | 0.004 | ug/L | 1 |
| 2-Methylnaphthalene | Toxicity | USEPA IRIS Reference Dose (i) | 28 | ug/L | |
| Naphthalene | Toxicity | California DHS Action Level in drinking water | 170 | ug/L | |
| | Tastes and Odors | Amoore and Hautala, <i>J. Applied Tox.</i> , Vol.3, No.6, 1983 | 21 | ug/L | |
| 5-Nitroacenaphthene | Toxicity | Cal/EPA Cancer Potency Factor (c) | 0.27 | ug/L | |
| 6-Nitrocrysene | Toxicity | Public Health Goal for benzo(a)pyrene & OEHHA PEFs | 0.0004 | ug/L | 10 |
| 2-Nitrofluorene | Toxicity | Public Health Goal for benzo(a)pyrene & OEHHA PEFs | 0.4 | ug/L | 0.01 |
| 1-Nitropyrene | Toxicity | Public Health Goal for benzo(a)pyrene & OEHHA PEFs | 0.04 | ug/L | 0.1 |
| 4-Nitropyrene | Toxicity | Public Health Goal for benzo(a)pyrene & OEHHA PEFs | 0.04 | ug/L | 0.1 |
| Pyrene | Toxicity | USEPA IRIS Reference Dose (i) | 210 | ug/L | |

Water Quality Numerical Limits for Petroleum Fuel Mixtures, Constituents and Additives

Notes for Table 1:

- (a) Water Quality Objectives for groundwater from the *Water Quality Control Plan (Basin Plan) for the Sacramento River Basin and the San Joaquin River Basin*, Fourth Edition. Similar language is found in the Tulare Lake Basin Plan.

Chemical Constituents

Ground waters shall not contain chemical constituents in concentrations that adversely affect beneficial uses.

At a minimum, ground waters designated for use as domestic or municipal supply (MUN) shall not contain concentrations of chemical constituents in excess of the maximum contaminant levels (MCLs) specified in the following provisions of Title 22 of the California Code of Regulations, which are incorporated by reference into this plan: Tables 64431-A (Inorganic Chemicals) and 64431-B (Fluoride) of Section 64431, Table 64444-A (Organic Chemicals) of Section 64444, and Tables 64449-A (Secondary Maximum Contaminant Levels-Consumer Acceptance Limits) and 64449-B (Secondary Maximum Contaminant Levels-Ranges) of Section 64449. This incorporation-by-reference is prospective, including future changes to the incorporated provisions as the changes take effect. At a minimum, water designated for use as domestic or municipal supply (MUN) shall not contain lead in excess of 0.015 mg/l. To protect all beneficial uses, the Regional Water Board may apply limits more stringent than MCLs.

Toxicity

Ground waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life associated with designated beneficial use(s). This objective applies regardless of whether the toxicity is caused by a single substance or the interactive effect of multiple substances.

Tastes and Odors

Ground waters shall not contain taste- or odor-producing substances in concentrations that cause nuisance or adversely affect beneficial uses.

- (b) Primary MCLs are human health based, but also may reflect other factors relating to technologic and economic feasibility of attainment and monitoring in a water distribution system and at the tap. These factors may not be relevant for the water resource.
- (c) 1-in-a-million cancer risk estimate derived from published oral cancer slope factor by assuming 2 liters/day water consumption and 70 kg body weight.
- (d) If adopted as proposed, this limit would become the numerical limit used to interpret this objective.
- (e) Health advisory = 4000 ug/L for 10 day exposure or less. No lifetime exposure advisory has been developed. However, lifetime health advisories are normally at least ten-fold lower than 10-day advisories. Therefore, a level of 400 ug/L would be a reasonable estimate of a lifetime protective level.
- (f) Secondary MCLs are human welfare based, but also may reflect other factors relating to technologic and economic feasibility of attainment and monitoring in a water distribution system and at the tap. These factors may not be relevant for the water resource.
- (g) Value listed is for 1,3,5-trimethylbenzene. Taste and odor treshold should be similar for 1,2,4-trimethylbenzene.
- (h) Liability under Proposition 65 may also exist for responsible parties where levels in water exceed 0.25 ug/L.
- (i) Listed value assumes 2 liters/day water consumption, 70 kg body weight, and 20% relative source contribution from drinking water.
- (j) Concentrations of individual PAHs are adjusted by dividing the concentrations by the potency equivalency factors (PEFs) in the table on the following page. The limit applies to the sum of these adjusted concentrations.